PROCEEDINGS OF THE BIOLOGICAL SOCIETY OF WASHINGTON
115(3):605–610. 2002.

Presence of *Pyromaia tuberculata* (Lockington, 1877) adults and larvae in the Argentine continental shelf (Crustacea: Decapoda: Majoidea)

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Abstract.—Adult and larvae of the majid crab *Pyromaia tuberculata* (Lockington) are reported for the first time from the Argentine continental shelf (38°21′S; 57°38′W). Males and ovigerous females were collected on oyster and mussel beds at 50 m depth. Zoeae and megalopae of *P. tuberculata* were also collected in plankton samples from Argentine coast (35°53′ to 37°55′S, 56°03′ to 57°24′W). The geographical range of *P. tuberculata* previously included the Pacific Ocean, and only Brazilian waters in the Atlantic.

The spider crab *Pyromaia tuberculata* (Lockington, 1877), originally described from San Diego, U.S.A., is now known to range in the eastern Pacific, from México to Colombia (Rathbun 1925, Garth 1958). It was introduced in the western Pacific and New Zealand (Carlton 1987, Morgan 1990, Furota 1996a). The first record in the western Atlantic was by Melo et al. (1989) for southern Brazil, from Rio de Janeiro to Paraná. The zoeal morphology of *P. tuberculata* was described based on Pacific specimens by Webber & Wear (1981) and Terada (1983), and the complete larval development based on Atlantic specimens by Fransozo & Negreiros-Fransozo (1997). The life cycle of *P. tuberculata* was studied in a polluted area of Tokyo Bay by Furota (1996a, 1996b). The familial classification and definition of *Pyromaia,* and the distribution of the six species known in this genus were recently reviewed by Lemaitre et al. (2001, and note added proof), who provided a key to the identification of five of the species. Since the familial and subfamilial classification of *Pyromaia* are still controversial (see Lemaitre et al. 2001), we decided to use the superfamilial classification (Majoidea) in the tittle of this article, with no reference to the familial or subfamilial status.

In the present study we document for the first time the presence of adult and larvae of *Pyromaia tuberculata* in the Argentine continental shelf.

Materials and Methods

Adult males (n = 3) and ovigerous females (n = 3) of *Pyromaia tuberculata* were collected using the BIP *Capitán Cánepa* (Instituto Nacional de Investigación y Desarrollo Pesquero, Argentina) on the continental shelf (38°21′S, 57°38′W, Fig. 1) on 25 September 2000 at a depth of 50 m. Samples were obtained with a dredge. Additional specimens of *Pyromaia tuberculata*

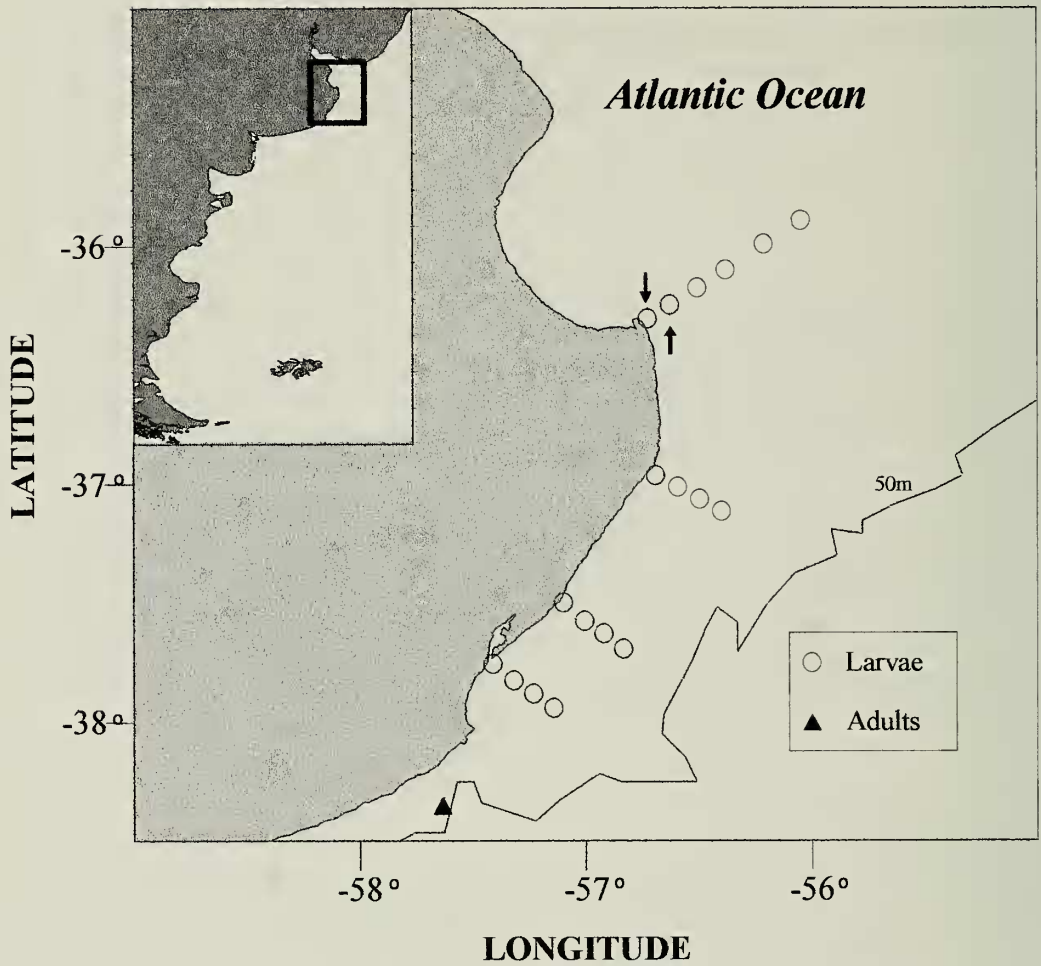

Fig. 1. Localities at which larvae (zoeae and megalopae, circles) and adults (triangles) of *Pyromaia tuberculata* were collected in the Argentine continental shelf. Arrows indicate higher larval density sites.

were obtained subsequently in the same area. The maximum length (CL) and width (CW) of carapace and length of rostrum (LR) measured ventrally, from the insertion of antennulae to tip of rostrum, were obtained using a vernier caliper and a stereomicroscope furnished with a micrometer eyepiece (6.7×).

Larvae were obtained from coastal plankton samples collected using the BIP *Capitán Cánepa* in October, November and December 1999, and February 2000, at 18 fixed stations, from 35°53′ to 37°55′S, and from 56°03′ to 57°24′W (Fig. 1). Plankton samples were collected with a Hydro-bios multinet (diameter, 0.5 m; 300 μm mesh) at different depths (1 to 17 m). The volume of filtered water was calculated on the basis of ship speed and trawling time. Water temperature and salinity were measured with a CTD. Samples were preserved in 4% formaldehide solution prepared with sea water. The following measurements were taken of the larvae: carapace length of zoea I and II, carapace length and width of megalopae.

Pyromaia tuberculata (Lockington, 1877)

Material examined.—Atlantic Ocean. 38°21′S, 57°38′W, 50 m, 25 Sep 2000, coll

L. Schejter: 3 ♂♂, CL: 7.8–15.6 mm, RL: 1.2–2.6 mm, CW: 6.5–12.3 mm, 3 ♀♀ CL: 10.5–12.8 mm, RL: 1.5–1.7 mm, CW: 7.8–9.8 mm.—From 35°53′ to 37°55′S and from 56°03′ to 57°24′W, 235 zoeae I, 227 zoeae II, and 622 megalopae.—23°27′S, 45°02′W, Bay of Ubatuba, São Paulo, Brasil, Feb. 2000, 1 ♂♂ CL: 19.2 mm, RL: 3.2 mm, CW: 13.9 mm, 2 ♀♀ CL: 13.5–19.1 mm, RL: 2.3–3.3 mm, CW 9.6–13.5 mm.

Other material examined.—Zoeae I, zoeae II, and megalopae reared in the laboratory by T. Luppi from 1 ovigerous female collected on 25 Sep 2000 (38°21′S, 57°38′W); hatching 4 Oct 2000.—Zoeae I, zoeae II, and megalopae reared in the laboratory by A. Fransozo, M.L. Negreiros Fransozo and F. Marques from Ubatuba females, deposited in the collections of the Grupo de Estudos em Biologia, Ecologia e Cultivo de Crustáceos (NEBECC), numbers #00077, 00093, 00093, respectively.

Remarks on morphology of adults.—Adults showed most of the diagnostic characters described by Rathbun (1925:133), Garth (1958:87) and Hendrickx (1999:78). The sternal view of male first pleopod tips agreed with the illustrations by Garth (1958:513, pl E., fig. 7), and Lemaitre et al. (2001:766, fig 5e).

Other observed characteristics were: surface of carapace granulate and tuberculate, pubescent, often with epibionts; first abdominal segment with a short spine, pointing backward; third maxilliped, chelipeds and abdomen of both sexes granulate, as well as the sternum of males; most of the inner part of cheliped propodus and dactylus with a row of piramidal teeth; dactyls of walking legs spinulose. Although there are median tubercles on the cardiac and intestinal regions of the carapace, a third, gastric tubercle, is absent.

The ratios between carapace and rostrum length and between carapace length and width were 6.83 ± 0.54 and 1.28 ± 0.06 (Argentine specimens, $n = 6$), and 5.87 ± 0.11 and 1.40 ± 0.02 (Brazilian specimens, $n = 3$). The ratios of northern Pacific specimens, calculated from Garth's (1958:89) data, were 6.28 and 1.28 for a male, and 23.50 and 1.10 for another male, larger, but with a relatively shorter rostrum. A linear relationship between and between CL and CW (*ANOVA*, $F = 79.5$, $p < 0.0001$) was observed when all available data (from Brasil, Argentina, and Garth 1958) were pooled (Fig. 2). Although CL and RL were not significantly related (*ANOVA*, $F = 4.66$, $p = 0.0592$), the power of the test was below that desired (0.4727, $\alpha = 0.05$), and this negative finding should be interpreted cautiously.

Habitat of adults.—The bottom was characterized by oyster (*Ostrea puelchana*) and mussel (*Mytilus edulis*) beds. Other brachyuran crab species found were the majids *Collodes rostratus* A. Milne-Edwards, *Leucippa pentagona* H. Milne Edwards, and *Rochinia gracilipes* A. Milne-Edwards, the xanthid *Pilumnoides hassleri* A. Milne-Edwards, and the portunid *Coenophthalmus tridentatus* A. Milne-Edwards.

Remarks on morphology of larvae.—Some zoeae and megalopae found in plankton samples collected in coastal argentine waters were identified as *Pyromaia tuberculata,* after a comparison with laboratory reared larvae from Argentina and Ubatuba (Brazil). They had a similar morphology as that described by Fransozo & Negreiros-Fransozo (1997).

The carapace length of zoeae I and II (highest density sites, Table 1) were 0.68 ± 0.03 mm and 0.98 ± 0.03 mm, respectively ($n = 10$). The carapaces of megalopae measured 1.27 ± 0.04 mm (length), and 0.95 ± 0.05 mm (width; $n = 15$). The ratio between length and width was 0.74.

Habitat of larvae.—Larvae were collected in coastal waters with temperatures ranging from 11.6°C (October) to 24.6°C (February), and salinities ranging from 14.4 to 34.0 PSU. The lowest salinities (<20 PSU) were registered in superficial waters (<4 m) near the Rio de la Plata estuary. Most larvae were collected during October (71% of all zoeae and 49% of all megalopae) and

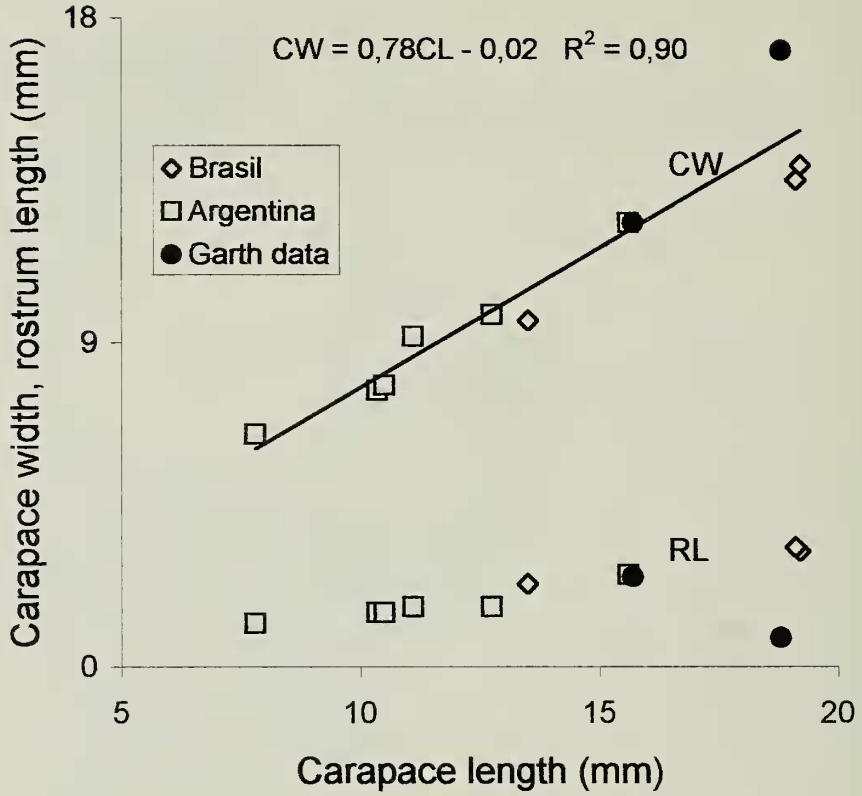

Fig. 2. *Pyromaia tuberculata.* Relationships between carapace length (CL), rostrum length (RL), and carapace width (CW) of specimens from different localities: Argentina Continental Shelf, Ubatuba Bay, Brasil, and Mexico.

November (18% and 45%, respectively) cruises. The highest density of both zoeae and megalopae was observed in two estuarine sites on 17 and 18 November 1999 (Fig. 1). The depth of collection and the environmental conditions of the highest density samples are summarized in Table 1.

Discussion

The Decapod Crustaceans of Argentine coastal waters have been carefully studied by Boschi (1964, 2000) and Boschi et al. (1992). However, *P. tuberculata* had not been reported in this region until this study.

Table 1.—*Pyromaia tuberculata* larvae collected in the field. Environmental conditions of the highest density sites (17 and 18 November 1999).

Longitude	Latitude	Bottom (m)	Temperature (°C)	Salinity (psu)	Depth (m)	Density (zoeae/m³)	(megalopae/m³)
56°37′25″	36°14′49″	15	19	14.84	2.1	0.28	0.13
			17.93	20.33	6.3	0.41	0.61
			16.66	29.21	10	0.13	0.25
56°30′14″	36°10′22″	18	19.32	16.33	2.7	0.11	0.01
			17.99	26.91	9.2	0.25	0.11
			16.99	29.87	15.2	0	0.07

This Majid species has been considered an invasive species, since it has colonizated East Asia and New Zealand waters (see Furota 1996a). It is possible that *P. tuberculata* may have recently been introduced to Argentine waters from the Pacific through larvae in ship ballast water, or by natural dispersion from Brazilian populations. In the latter case, larvae would have been transported by coastal currents passing through an important biogeographical barrier: the huge estuary of the Rio de la Plata (Spivak 1997, Mianzán et al. 2001). The discharge of this river during the last 30 years shows a periodic minimum each 3 or 4 years (Mianzán et al. 2001). These authors stated that literature reports on the presence of south Brazilian organisms as far as 38°S, "seem to be in phase with those minimum discharge events" and reported a pronounced discharge decrease fron January to April 2000 (Mianzán et al. 2001). Recently, other crabs not known further south than Brasil, such as *Arenaeus cribrarius,* have been reported in Argentine waters (Scelzo 2001).

The ratio between carapace length and width was similar in specimens from Argentina, Brasil, and the subspecies described by Garth (1958) as *Pyromaia tuberculata mexicana* and *P. tuberculata tuberculata.* The ratio between carapace and rostrum length was used by Garth (1958) to distinguish *P. t. mexicana,* characterized by a shorter rostrum, from *P. t. tuberculata.* Later, Hendrickx (1990, 1999) synonymized both subspecies on the basis of >800 specimens collected in the Gulf of California. Data from Argentina and Brasil agreed with those *P. tuberculata* with longer rostrum (*P. t. tuberculata* sensu Garth 1958). However, it is also possible that the relative decrease of rostrum length may be due to allometric growth or wear of the rostrum tip.

Acknowledgments

This study was funded by a grant from Universidad de Mar del Plata (15/E149) to EDS, and by fellowships of Consejo Nacional de Investigaciones Científicas de la República Argentina to TAL, and the Comisión de Investigaciones Científicas de la Provincia de Buenos Aires to LS. We are grateful to the staff from the the Instituto Nacional de Investigación y Desarrollo Pesquero (Argentina) for the invitation to LS and EDS to take part in the BIP *Capitán Cánepa* research cruises; to E. Boschi for his continuous encouragement and help; to M. L. Negreiros-Fransozo, A. Fransozo and F. P. Marques (Universidad Estadual Paulista, Brazil) for the loan of material deposited in the NEBECC collections; and to R. Lemaitre, T. Furota, and two anonymous reviewers for their suggestions and valuable comments.

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